WL-TR-94-3096





# UNSTEADY TRANSONIC WIND TUNNEL TEST ON A SEMISPAN STRAKED DELTA WING MODEL OSCILLATING IN PITCH

Part 3: Selected Data Points for Simulated Maneuvers

Atlee M. Cunningham, Jr. Lockheed Fort Worth Company Forth Worth TX

and

Ruud G. den Boer

C. S. G. Dogger

E. G. M. Geurts

A. P. Retél

R. J. Zwaan

National Aerospace Laboratory (NLR)

Amsterdam, The Netherlands

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LAWRENCE J. HUTTSELL

Aerospace Engineer Aeroelasticity Section

Structural Dynamics Branch

Cocod W. Model

TERRY M. HARRIS

Technical Manager Aeroelasticity Section

Structural Dynamics Branch

JOSEPH W. MOSCHLER, MAJ, USAF

Chief, Structural Dynamics Branch

Structures Division

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A wind tunnel investigation was conducted in 1992 to investigate the unsteady aerodynamic aspects of transonic high incidence flows over a simple straked wing model. This test was designed to show how							
low speed vortex type flows evolve into complicated shock vortex interacting flows at transonic speeds.							
Requirements for this test were based on a low speed test conducted in 1986 on a full span model in the							
NLR Low Speed Tunnel. The transonic model was a semispan version of the low speed model with							
some modifications. It was equipped with a three-component semispan balance to measure total wing							
loads, seven rows of high response pressure transducers to measure unsteady pressures and 15 vertical							
accelerometers to measure model motion and vibrations. The model was oscillated sinusoidally in pitch at various amplitudes and frequencies for mean model incidences varying from 4° to 48°. In addition,							
maneuver type transient motions of the model were tested with amplitudes of 16° and 30° total rotation at various starting angles. The test was conducted in the NLR HST in the Mach range of 0.225 to 0.90 with							
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#### **FOREWORD**

This report summarizes the results of an investigation into transonic high incidence unsteady aerodynamics. Transonic wind tunnel tests were conducted for a semispan straked delta wing model oscillating in pitch at high incidences.

This test was conducted under a cooperative program of research between the Lockheed Fort Worth Company (LFWC), Fort Worth, Texas, USA (Formerly the Fort Worth Division of General Dynamics until 28 February 1993) and the National Aerospace Laboratory (NLR), Amsterdam, The Netherlands. The test was conducted in April/May 1992. The models and corresponding support system were designed at NLR under an earlier separate program with funding from the Fort Worth Division of General Dynamics (now LFWC) and NLR. The fabrication of models, test preparation, wind tunnel test and reporting were performed at NLR under a subcontract from LFWC. This work was funded under Air Force contract F33657-84-C-0247 (CCP 4551) for the Aeronautical Systems Center, Wright-Patterson Air Force Base, Ohio. The work was administered by Mr. F. Zapata of the F-16 SPO (ASC/YPEF) and Mr. L. J. Huttsell of the Flight Dynamics Directorate of Wright Laboratory (WL/FIBG) Wright-Patterson Air Force Base, Ohio under work unit 24010292.

The program manager was Dr. A. M. Cunningham, Jr. at LFWC. The principal investigators were Dr. Cunningham at LFWC, Mr. R. G. den Boer for the wind tunnel test programs at NLR. Mr. den Boer was assisted by the following NLR specialists: C. D. G. Dogger, E. G. M. Geurts, A. P. Retel and R. J. Zwaan. The authors would like to acknowledge the following person who contributed substantially in the project:

Mr. E. W. M. Slijkerman for the design of the wind tunnel model and support; Messrs. T. Horsman and F. Hofman for the fabrication and instrumentaion of the model; and Messrs. O. van Teunenbroek and A. van der Kamp for their contribution in the software development.

The test program for the straked delta wing is documented in three separate reports. This report (Part 3) contains selected data for simulated maneuvers. Part 1 contains a description of the model, test setup, data acquisition, and data processing. Part 2 contains selected test points for harmonic oscillation. Parts 1 and 2 are published as WL-TR-94-3094 and WL-TR-94-3095, respectively. An overview of this test program is also published as WL-TR-94-3017.

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#### SUMMARY

An unsteady transonic wind tunnel test is reported for a highly instrumented semispan simple straked delta wing model. Harmonic pitch oscillation as well as maneuver simulation were performed.

Appendix A of this part presents the aerodynamic responses on the maneuver sequence performed with the semispan straked delta wing model for data points 306, 480 and 656. All the quantities as presented for the data points with hamronically oscillating model (see Part 2), extended by inertia loads as separate quantities, are presented both as a time trace and as a cross-plot with the incidence signal. Due to the different ranges of Cp's in the three data points, three different scales are used for these plots. The plots of all the other quantities have the same scale for the three data points, except for CN\_u\_6 (dpn 306 and 480) and CN\_t\_1, Cl\_u\_6 (dpn 306). The time traces are also made available on floppy disks.

The rationale for selected these data points is discussed in Section 7 of Part 1. Table 5 in Part 1 provides a convenient cross-reference of conditions and data point numbers.

For nondimensionalization, symbols and definitions the reader is referred to Part 1 (see page ix-xiv of Part 1).

APPENDIX A Plots of the Responses on Maneuver Sequences for Data Points 306, 480, 656



































































































































































































































































































































































































































